DePere Lock and Dam
At the 7 mile marker on the northeast bank of the Lower Fox River
DePere
Brown County
Wisconsin

HAER No. WI-86

HAER
WIS
5-DEPER,
2-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Rocky Mountain System Support Office
National Park Service
P.O. Box 25287
Denver, Colorado 80225-0287

HISTORIC AMERICAN ENGINEERING RECORD

HAER
WIS
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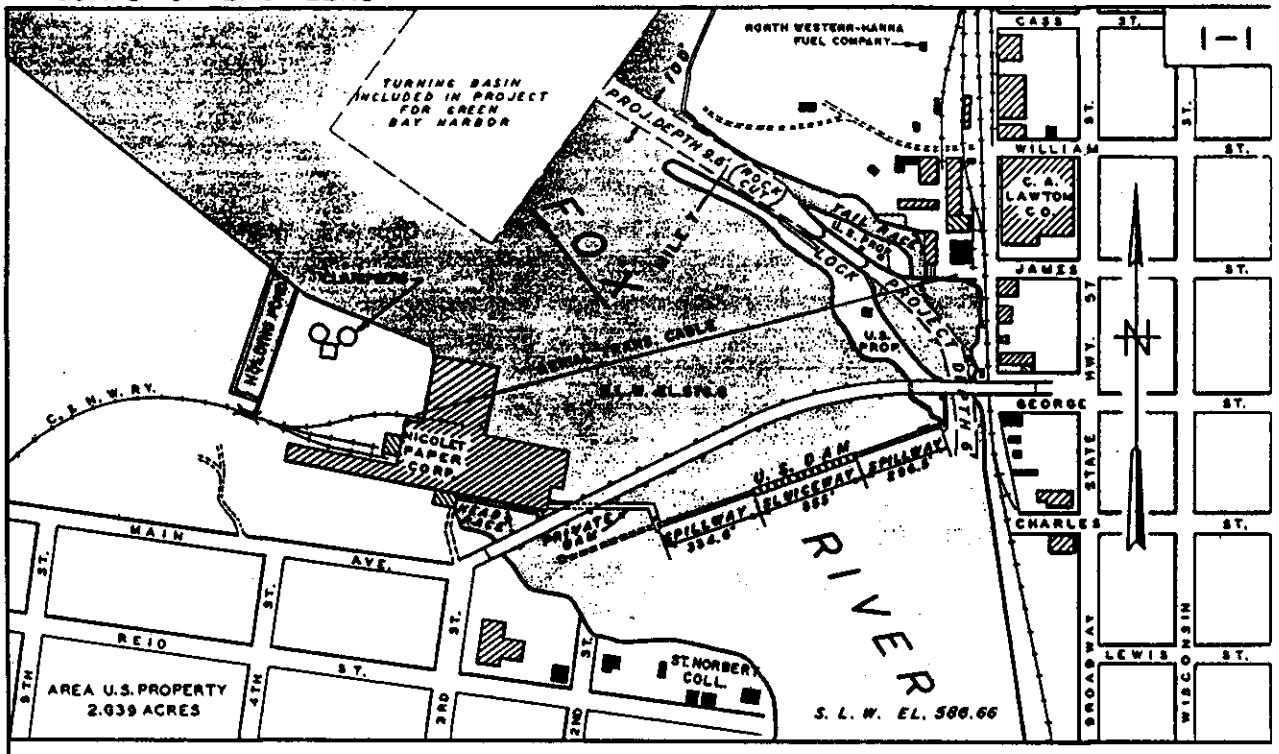
2-

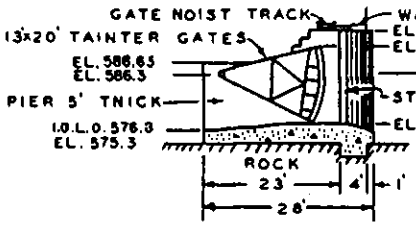
DE PERE LOCK AND DAM

HAER NO. WI-86

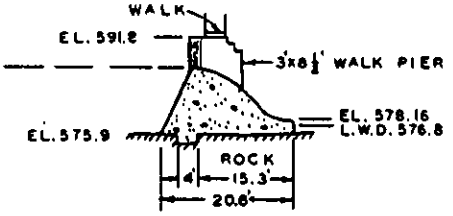
Location:	The De Pere Lock and Dam is located on the northeast bank of the Fox River at river mile 7 in the French Lots PC 28 and 32, T23N, R20E, Civil Towns De Pere and Lawrence, Brown County, Wisconsin. UTM: East end of dam 16/415470/4922040, West end of dam 16/415170/4921950; Center of Lock 16/515390/4922200; USGS Quadrangle: De Pere, Wisconsin 7.5' series
Date of Construction:	1836 – 1936
Engineer:	United States Army Corps of Engineers with Contractors
Architect:	United States Army Corps of Engineers with Contractors
Present Owner:	United States Army Corps of Engineers
Present Use:	The De Pere Lock and Dam Complex is used by recreational water craft to enter or exit the Lower Fox River.
Significance:	The De Pere Lock and Dam allows passage from Green Bay in Lake Michigan around rapids and into the Lower Fox River. The complex is the first link in a series of locks and dams that allows passage from De Pere to Menasha on the Lower Fox River Waterway System.
Project Information:	This documentation was undertaken in 1995 in accordance with requirements detailed in a June 19, 1994 letter from Gregory D. Kendrick, Chief, History Branch, NPS to Dale Monteith, Acting Chief, Planning Division, USACOE, Detroit District. The Lower Fox system remains basically operational but was placed in caretaker status by the USACOE in 1982. The USACOE plans to divest itself of the Lower Fox system as soon as is feasible; therefore, NPS requested this documentation. All documentation conforms to HAER standards. Dr. John D. Richards, Principal Investigator; Georgia A. Lusk, Patricia B. Richards, and Robert J. Watson, Project Archivists with Great Lakes Archaeological Research Center, Inc.; Joseph Paskus, Project Photographer.

CORPS OF ENGINEERS U. S. ARMY

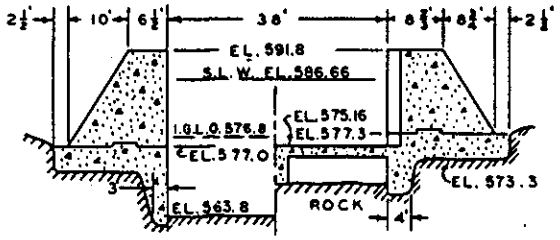




SECTION
SLUICEWAY

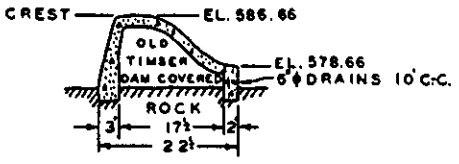


SECTION
SPILLWAY



SECTION
LOCK CHAMBER

SECTION
UPPER GATE
RECESS



SECTION
PRIVATE DAM

STANDARD LOW WATER AND ELEVATIONS ARE REFERRED TO THE MEAN WATER LEVEL AT FATHER POINT, QUEBEC, I.G.L.D. (1955) (INTERNATIONAL GREAT LAKES DATUM)

PROJECT DEPTH IS REFERRED TO STANDARD LOW WATER

LOCK

STRUCTURE DATA

AVAILABLE LENGTH	146.0'
CLEAR WIDTH	36.0'
LIFT, MEAN STAGE	8.9'
UPPER MITER SILL	EL. 577.16
LOWER MITER SILL	EL. 564.80
BREAST WALL	EL. 577.16

DAM

STRUCTURE DATA

14 SLUICE GATES
LENGTH OF CLEAR SPILLWAY 598.4'
LENGTH OF CLEAR SLUICEWAY 260.0'
12" FLASHBOARDS AUTHORIZED
JAN. 27, 1896 (E.O. 13,662)

PRIVATE DAM

LENGTH OF CLEAR SPILLWAY 332.0'

DE PERE LOCK AND DAM
FOX RIVER
WISCONSIN

IN 1 SHEET SHEET NO. 1

SCALE OF FEET
100 0 500 1000 1200

CORPS OF ENGINEERS CHICAGO, ILLINOIS

30 SEP. 1978

DE PERE LOCKS AND DAM

General Description

The De Pere Lock and Dam facility is located in the City of De Pere, Wisconsin near the Main Avenue bridge on the northeast shore of the Fox River. Built between 1930 and 1941 the facility consists of a dam, canal, lock, lockkeeper's residence, lock shelter, garage, and storage shed.

History

Construction of the first lock and dam facility at De Pere was begun in 1836. This dam was subsequently washed away by a storm in 1847.[1] In 1848, the Board of Public Works of the newly formed State of Wisconsin appointed engineer Condy R. Alton to survey and assess the condition of the existing dams on the Fox River and suggest navigational improvements to other areas of the river.[2]

In his assessment of the De Pere Lock and Dam, Alton reported the existing wooden lock and dam was in disrepair and suggested the lock be replaced by one built of stone.[3] Construction of a composite lock at De Pere began in 1849, coincident with construction of other facilities along the Fox-Wisconsin Waterway. By the summer of 1850, construction of the De Pere lock was complete, with the first riverboat passing through the facilities on June 14, 1850.[4]

In 1866, the federal government surveyed the navigation facilities of the entire Fox-Wisconsin Waterway. During the survey, the De Pere Lock and Dam facilities were measured, and noted to consist of a 6 foot high, 1,400 foot long dam, bypassed by a 750 foot long canal containing a composite lock measuring 140 feet in length and 35 feet in width. The length of the De Pere lock was noted to be some twenty feet shorter than the lengths of other locks on the Fox-Wisconsin Waterway.[5]

Following the purchase of the lock and dam system of the Fox-Wisconsin Waterway by the federal government in 1872, another assessment survey was conducted by government surveyors. During the course of the survey, it was found that the length of the De Pere locks had been increased some 23 feet since 1866. The dam at De Pere was listed as being in "decent shape".[6]

Subsequent to the 1872 survey, the United States Army Corps of Engineers embarked on a program designed to keep the Fox-Wisconsin system open to navigation.[7] This program consisted of regular maintenance and construction of lock and dam facilities as well as dredging of navigation canals.[8] At De Pere, work began with the construction of a lockkeeper's house in 1879.[9]

Throughout the late 1880s and early 1900s, several repairs were made to the lock facilities at De Pere, including the replanking of the lock chamber as needed.[10] In 1887, the lock chamber was lowered by 2.5 feet and entirely replanked. Additionally, the lock's mitre sill was secured to the rock floor, and seams in the floor were filled with rock and mortar.[11] New timber lock gates and valves were installed in 1905, and wooden gate spars which had rotted were replaced in 1907.[12] Between 1912 and 1913, the original lockkeeper's residence at the De Pere Lock and Dam facility was replaced by a new dwelling, at a total cost of $ 3, 052.[13]

In 1927, in the Annual Report of the Chief of Engineers, the De Pere dam was noted to be in a state of decay, and construction of a concrete replacement was suggested as soon as funds were available. The report also suggested that prior to the rebuilding of the dam, a sluiceway portion "should be provided to increase discharge capacity and reduce present danger of washout".[14]

Construction of the sluiceway began in 1928, and was completed in 1929, at which time construction of a concrete spillway was begun.[15] By 1930, the rebuilding of the De Pere dam was completed.[16] The De Pere dam has been altered little since its completion in 1930, apart from the cleaning and painting of the sluice gates in 1947 and 1948.[17]

In 1934, plans were made to replace the composite lock at De Pere with a concrete lock with steel gates. Construction was scheduled to take place from December to March in 1934-1935, and was to be completed during the winter of 1935-1936.[18] By 1936, the concrete lock was in place. The De Pere lock configuration has been altered little since 1936 apart from periodic cleaning and painting of the gates and steelwork. Additional minor alterations include various repairs and improvements to the canal banks.[19]

DE PERE DAM

The existing dam at De Pere has changed little structurally since it was rebuilt in concrete between 1928 and 1930. Oriented along a general SSW/NNE axis, the dam measures 986 feet in length and is comprised of three sections: (1) a spillways located on the eastern end of the dam; (2) a spillway on the dam's western bank and; (3) a centrally located sluiceway.[20] The dam is anchored to bedrock at the river's bottom, and maintains a standard low water pool elevation of 588.36 feet above mean sea level. Average depth ranges from 10 to 12 feet above the river bottom.[21] Due to unique engineering challenges poised by the Fox River, each section of the De Pere dam differs in design and construction from the other sections of the dam.

East Spillway

The east spillway, located closest to the De Pere lock, is 296 feet, 5 3/4 inches in length. The length of the east spillway is defined by the portion of the dam between the channel face of the easternmost dam abutment and the easternmost pier section of the sluiceway.[22]

The eastern end of the east spillway is connected to a concrete abutment which was constructed in 1925. The abutment is 15 feet 6 inches in length, and 14 feet 6 inches in height. The walls of the abutment are beveled from a thickness of 8 feet at the base to 3 feet 6 inches at the top. The beveled edge faces bankward. The upstream end of the abutment forms a U-shaped head, with the open end facing downstream. The head of the abutment is beveled on the interior side of the semi-circle from a base thickness of 4 feet to a 3 foot 6 inch thickness at the top. A support wall constructed perpendicular to the main axis of the abutment is located 21 feet 3 inches from the upstream extreme of the abutment head. This wall, which extends 11 feet from the abutment toward the bank, is slightly beveled on both faces from a 3 foot 6 inch thickness at the top to a 4 foot 6 inch basal thickness. The east abutment is secured to the bedrock at the bottom of the river by forty eight 7/8 inch by 18 inch metal dowels tied into the rock.[23]

The east spillway is comprised of 18 poured concrete construction sections.[24] Each construction section is anchored to the bedrock of the river bottom by twenty 1 inch by 18 inch steel anchor bolts grouted into the rock, and by eight 1 1/2 inch by 4 foot split iron dowels grouted into the rock at the upstream end of the section. In addition to the iron fasteners, a 4 foot wide concrete key, poured into a trench cut at a minimum depth of 2 feet into the bedrock, runs the entire length of the spillway, securing it to the river's bottom.[25]

The width of each individual construction section varies according to its position in the overall layout of the spillway. The construction section located adjacent to the east dam abutment is the widest of the east spillway sections, extending 17 feet 1/4 inches. The end section of the east spillway is tied onto the abutment by 4 foot lengths of 1 inch diameter steel bars spaced about 2

feet apart center to center. The western end section of the east spillway is the smallest construction section of the structure. Located adjacent to the first pier section of the dam's sluiceway, the west end section of the east spillway measures 12 feet 9 1/2 inches in width.[26] The section is tied to the first sluiceway pier section by 1 inch by 3 foot stub bolts screwed into 1 inch by 3 foot sleeve nuts in the sluice pier.[27] The remaining 16 sections of the east spillway are uniformly 16 feet 8 inches wide.

Aside from their differing widths, each construction section of the east spillway conforms to specifications of a generalized construction section plan. When measured parallel to the river channel, each construction section extends to a basal length of 20 feet 10 inches. The upstream face of the east spillway, is 5 feet 5 3/4 inches wide at the upstream base. This section is beveled at a 5V:12H pitch from the upstream base to a point further upstream by 1 foot 4 1/8 inch. From this point, the upstream face of the spillway curves toward the crest line at a 1 foot 6 inch radius. The downstream face of the east spillway, measuring 15 feet 4 1/4 inches horizontally from the crest line to the down stream edge, is constructed as a compound curve consisting of four tangental circles with radii of 8 feet, 15 feet, 7 feet, and 4 inches.[28]

When measured from the rock bottom of the Fox River, each construction section of the east spillway is approximately 10 feet 9 inches at the crest line. The crest line is the highest point of the spillway, maintaining an elevation of 588.36 feet above sea level. By comparison, the downstream "toe" of the spillway extends 2 feet 1 1/4 inches above the average elevation of the river bottom. Average elevation of the downstream toe is thus 579.6 feet above sea level.[29]

The spillway construction sections are secured together by a concrete mortise and tenon joint running the full height of each spillway section. The tenon, slightly beveled from a maximum width of 23 inches at its wide end to 21 inches at the smaller end, is secured in a 5 1/2 inch deep mortise in the adjoining construction section. A 1/8 inch by 12 inch steel plate securing the mortise to the tenon runs the full height of the section. The seams between each spillway section are filled by 1/8 inch thick construction joints, with 1/8 inch thick expansion joints at every third joint. At each expansion joint, a 1/32 inch by 15 inch soft copper sheet runs the entire height of the concrete mortise and tenon joint.[30]

Beginning at the eastern abutment, every third construction section of the east spillway supports a concrete pier which serves as a base for a metal walkway running the length of the spillway. The longitudinal centerline of each walk pier is located at a distance of 2 feet 4 1/2 inches from the western edge of the spillway construction section on which it is located.[31] There are a total of five walkway support piers located along the eastern spillway.

The walk piers of the eastern spillway are bullet shaped, with the parabolic end pointing upstream. Each pier measures 8 feet 6 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the pier sections maintain their maximum width of 3 feet for a length of 5 feet, at which point the sides begin to curve gently toward the tip of the parabola. Each side of the pier arches toward the upstream tip, maintaining a curve with a 5 foot circular radius.[32] The upstream nose of each of the walk piers is armored with a 5 foot 6 inch section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 inch by 18 inch steel bolts.[33]

The walk piers are tied into the spillway construction sections by two concrete keys, a triangular key located at the upstream end of the pier, and a rectangular key located at the downstream end.[34] Each side of the upstream key is approximately 2 feet, forming an equilateral triangle which points upstream. The base of the triangle is located 3 feet 6 inches from the upstream tip of the walkway. The long axis of the triangular key is aligned with the longitudinal centerline of the pier section. The rectangular key is located approximately 1 foot 6 inches from the downstream end of the pier

section. The key measures 2 feet on each side, and is centered on the longitudinal axis of the pier. Each key extends into the spillway construction section to a depth of 6 inches. In addition to the concrete keys, each walk pier is tied into the spillway construction section upon which it sits with 14 sections of 3/8 inch diameter rebar. The rebar sections are spaced 16 inches center to center, 3 inches inside the outer dimensions of the pier.[35]

In profile, the walk piers are somewhat rectangular, with concave bottoms conforming to the curved surfaces of the spillway construction sections. The piers were designed to attain a maximum elevation of 593.5 feet above sea level, so although the sides of the piers average 6 feet in height, the difference in elevation between the base of the pier and the 593.5 foot top elevation varies. Measured from the point of contact with the spillway construction section, the difference in elevation of the upstream end of the walkway piers from 593.5 feet above sea level is 6 feet, while the difference in elevation of the downstream end is 8 feet. On the downstream end of the pier there are two 12 inch steps which carry the elevation from 593.5 to 591.5 feet above sea level.[36] Thus, although the difference in elevation from 593.5 feet above sea level of the downstream base of the pier is 8 feet, the actual height of this section is 6 feet.

A walkway spans the entire length of the east spillway from the dam abutment to the first pier section of the sluiceway. The walkway over the east spillway consists of a total of twelve 49 foot 11 1/2 inch long sections of channel iron bolted onto the walkway pier sections with 3/4 inch by 18 inch split anchor bolts fitted with specially beveled washers. Each side of the walkway is comprised of 6 channel beams bolted end to end, and spaced 3 feet 5 1/4 inches apart so that the channels of opposite beams face one another. The interior space between the channel beams is spanned by thirty seven 3 foot 4 inch long I beams which have been bolted to the channel iron using L braces made of 2 inch sections of 6 by 4 by 3/8 inch angle iron and 1/2 inch by 1 1/2 inch machine bolts.[37] The horizontal I beam sections serve as support ribs spaced 8 feet 4 inches apart along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron are spaced at 16 foot 8 inch intervals the length of the spillway to form the uprights for a handrail. The majority of the east spillway handrail uprights are constructed of 4 foot sections of 2 1/2 by 2 1/2 by 3/8 inch angle iron. The two uprights located at the junction of the walkway and the east dam abutment are also 4 feet in height, but are constructed of thinner 2 1/2 by 2 1/2 by 3/16 inch angle iron. A taller upright, 5 feet 3/8 inches in height, is located on the upstream side of the east spillway walkway at its attachment with the sluiceway. This upright is connected to the first upright of the sluiceway walkway by two sections of 7 foot 1 1/16 inch long pieces of 2 1/2 by 2 1/2 by 3/16 inch angle iron that form a railing between the two walkways.[38]

The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. The second bolt used to secure the upright to the channel beam is located 9 inches above this lower bolt. On each side of the east spillway walkway, two 302 foot lengths of 1/2 inch galvanized 7 strand Siemens - Martin wire rope has been threaded through holes drilled in the walkway uprights. The upright holes are located 2 feet 3 inches and 3 feet 9 inches from the base of the walkway channel beam. The ends of the wire rope have been looped and secured with three bolt guy clamps, and connected to 3/4 inch eye bolts fastened to 3/4 inch turnbuckles.[39]

The decking of the spillway walkway is made up of 18 foot sections of 3 inch by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed onto 3 foot 2 inch sections of 4 inch by 4 inch beams which are bolted to the tops of the horizontal I

beam sections spanning the interior space between the channel beams.[40] In recent years, the original wooden decking of the walkway has been replaced with steel grating.

West Spillway

The western spillway is similar to the eastern spillway in many respects. The major difference between the two spillway sections is that the western spillway is noticeably longer than the eastern spillway, with an overall length of 334 feet 7 1/4 inches. The larger overall size of the western spillway relative to the eastern spillway is carried through in other dimensions as well. The generalized plans of the construction sections of the western spillway reveal that design height is 1 foot 3 inches higher, and design length is 1 foot 4 inches longer than the eastern spillway construction sections.[41]

The western spillway begins at the west end of the sluiceway, continuing 334 feet 7 1/4 inches to the west, where it connects to a concrete dam abutment which is in turn connected to a privately owned dam. The concrete abutment at the west end of the spillway, extends 22 feet 8 1/4 inches in length, 9 feet 9 inches in width, and is 16 feet 9 inches in high. The upstream end of the west abutment is rounded to form a semi-circle with a 4 foot 10 1/2 inch radius. Constructed entirely of form-poured concrete, the west abutment is secured to the bedrock bottom of the river by fourteen 1 1/2 inch by 4 foot split iron dowels that are sunk into the rock. Additionally, a 4 foot wide concrete key, poured into a trench cut at a minimum depth of 2 feet into the bedrock, runs the entire width of the abutment, further securing the west end to the river bottom.[42]

The west dam abutment and first spillway section of the west spillway of the government dam are joined to a privately owned timber crib dam by a poured concrete connector which bridges the approximate 13 foot span between the dams. The connector is roughly ell-shaped, with the longer side facing the channel. This section extends 21 feet from the private dam so that it overlaps the downstream surface of the first spillway section by some 8 feet. The surface of this section of the connector is beveled from a height of 6 feet 6 inches along the edge adjacent to the channel to a height of 7 feet 6 inches at the intersection with the western section of the connector. The western half of the connector is that part of the structure immediately adjacent to the west dam abutment. This portion of the connector is 7 feet 6 inches high, measuring 13 feet in length, and 7 feet 6 inches in width. The bankward wall is slightly beveled toward the top of the section, which is 7 feet 6 inches wide. The surface of the western section of the connector is flat, but is stepped toward the abutment by two 12 inch risers in order to compensate for the 4 foot 4 7/8 inch difference in height between the west abutment and the connector.[43]

The connector is fastened to the west abutment by a 15 foot 6 inch high by 3 foot wide concrete key extending 6 inches into the abutment, and is held fast to the bottom by fifteen 1 1/2 inch by 4 foot split steel dowels sunk into the bedrock. The section overlapping the spillway is tied to the bottom by twelve double cinch anchor bolts, and to the abutment with 1 foot by 4 foot rebar rods spaced 2 feet apart from center to center.[44]

The west spillway is comprised of 21 poured concrete construction sections.[45] Each construction section is anchored to the bedrock of the river bottom by twenty 1 inch by 18 inch steel anchor bolts grouted into the rock, and by eight 1 1/2 inch by 4 foot split iron dowels grouted into the rock at the upstream end of the section. Additionally, a 4 foot wide concrete key, poured into a trench cut at a minimum depth of 2 feet into the bedrock, runs the entire length of the spillway.[46]

The widths of individual construction sections of the west spillway vary according to its position in the overall layout of the spillway.[47]

The construction section located adjacent to the sluiceway pier is the widest of the west spillway sections, measuring 16 feet 11 1/2 inches across. The section is tied to the sluiceway pier by 3 foot sections of 1 inch diameter stub bolts screwed into 1 inch by 3 foot sleeve nuts imbedded in the sluiceway pier. The smallest section of the west spillway, measuring 12 feet in width, is located adjacent to the west abutment. The section is tied to the abutment by 1 inch by 3 foot stub bolts screwed into 1 inch by 3 foot sleeve nuts imbedded in the sluice pier.[48] The remaining 16 sections of the east spillway are uniformly 16 feet 8 inches wide.

Although differing in width, each construction section of the east spillway conforms to specifications of a generalized construction section plan. When measured parallel to the river channel, each section has a basal length of 22 feet 2 inches. The upstream face of the east spillway is beveled at a 5V:12H pitch from the upstream base to a point located upstream by 1 foot 4 1/8 inches. From this point, the upstream face of the spillway curves toward the crest line at a 1 foot 6 inch radius. The downstream face of the west spillway, measuring 16 feet 2 1/4 inches horizontally from the crest line to the down stream edge, is constructed as a compound curve consisting of four tangental circles with radii of 8 feet, 15 feet, 7 feet, and 4 inches.[49]

Measured from the rock bottom of the Fox River, each construction section of the west spillway achieves a height of approximately 10 feet 9 inches at the crest line. This forms the highest point of the spillway, reaching an elevation of 588.36 feet above sea level. By comparison, the downstream "toe" of the west spillway rises 2 feet 6 inches from the average elevation of the river bottom, to attain an average elevation of 578.86 feet above sea level.[50]

The spillway construction sections are secured together by a concrete mortise and tenon joint running the full height of each spillway section. The tenon, slightly beveled from a width of 23 inches at its widest end to 21 inches at the smaller end, is secured in a 5 1/2 inch deep mortise in the adjoining construction section. A 1/8 inch by 12 inch steel plate securing the mortise to the tenon extends the full height of the section. The seams between each spillway section are filled by 1/8 inch thick construction joints, with 1/8 inch thick expansion joints at every third joint. At each expansion joint, a 1/32 inch by 15 inch soft copper sheet extends the entire height of the concrete mortise and tenon joint.[51]

Beginning at the western dam abutment, every third construction section of the west spillway supports a concrete pier which serves as a base for a metal walkway running the length of the spillway. The longitudinal centerline of each walk pier is located at a distance of 2 feet 4 1/2 inches from the western edge of the spillway construction section on which it is located.[52] There are a total of six walk support piers located on the western spillway.

The walk piers of the western spillway are similar to those of the eastern spillway. Each is bullet shaped with the parabolic end pointing upstream. The walk piers extend 8 feet 6 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the pier sections maintain a maximum width of 3 feet for a length of 5 feet, at which point the sides begin to curve gently toward the tip of the parabola. Each side of the pier arches toward the upstream tip, maintaining a curve with a 5 foot circular radius.[53] The upstream nose of each of the walk piers is armored with a 5 foot 6 inch section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 inch by 18 inch steel bolts.[54]

The walk piers are tied to the spillway construction sections by two concrete keys, a triangular key located at the upstream end of the pier, and a rectangular key located at the downstream end.[55] Each side of the upstream key is approximately 2 feet, forming an equilateral triangle which points upstream. The base of the triangle is located 3 feet 6 inches from the upstream tip of the walkway pier. The long axis of the triangular key is aligned with the longitudinal centerline of the pier

section. The rectangular key is located approximately 1 foot 6 inches from the downstream end of the pier section. The key measures 2 feet on each side, and is centered on the longitudinal axis of the pier. Each key extends into the spillway construction section to a depth of 6 inches. In addition to the concrete keys, each walk pier is tied to the spillway construction section upon which it sits with 14 sections of 3/8 inch diameter rebar. The rebar sections are spaced 16 inches center to center, 3 inches inside the outer dimensions of the pier.[56]

In profile, the walk piers are somewhat rectangular, with concave bottoms conforming to the curved surfaces of the spillway construction sections. The piers were designed to attain an elevation of 593.5 feet above sea level at their topmost surface, so although the sides of the piers average 6 feet in height, the difference in elevation of the base of the pier from the 593.5 foot elevation varies. Measured from the point of contact with the spillway construction section, the difference in elevation of the upstream end of the walk piers is 6 feet, while the difference in elevation of the downstream end is 8 feet. On the downstream end of the pier there are two 12 inch risers which carry the elevation from 593.5 to 591.5 feet above sea level.[57] Thus, although the difference in elevation from 593.5 feet above sea level of the downstream base of the pier is 8 feet, the actual height of the downstream end of the pier is 6 feet.

A walkway spans the entire length of the west spillway from the dam abutment to the first pier section of the sluiceway. The walkway over the west spillway consists of a total of fourteen 48 foot 2 1/2 inch long sections of channel iron bolted to the walk pier sections with 3/4 inch by 18 inch split anchor bolts fitted with specially beveled washers. Each side of the walkway is comprised of 7 channel beams bolted end to end, and spaced 3 feet 5 1/4 inches apart so that the channels of opposite beams face one another. The interior space between the channel beams is spanned by forty three 3 foot 4 inch long I beams which have been bolted to the channel iron using L braces made of 2 inch sections of 6 by 4 by 3/8 inch angle iron and 1/2 inch by 1 1/2 inch machine bolts.[58] The horizontal I beam sections serve as support ribs spaced 8 feet 4 inches apart along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron are spaced at 16 foot 8 inch intervals the length of the spillway to form the uprights for a handrail. The majority of the west spillway handrail uprights are constructed of 4 foot sections of 2 1/2 by 2 1/2 by 3/8 inch angle iron. The two uprights located at the junction of the walkway and the west dam abutment are also 4 feet in height, but are constructed of thinner 2 1/2 by 2 1/2 by 3/16 inch angle iron. A taller upright, 5 feet 3/8 inches in height, is located on the upstream side of the west spillway walkway at its attachment with the sluiceway. This upright is connected to the first upright of the sluiceway walkway by two sections of 7 foot 1 1/16 inch long pieces of 2 1/2 by 2 1/2 by 3/16 inch angle iron that form a railing between the two walkways.[59]

The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. The second bolt used to secure the upright to the channel beam is located 9 inches above this lower bolt. On each side of the west spillway walkway, two 302 foot lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights. The upright holes are located 2 feet 3 inches and 3 feet 9 inches from the base of the walkway channel beam. The ends of the wire rope have been looped and secured with three bolt guy clamps, and connected to 3/4 inch eye bolts fastened to 3/4 inch turnbuckles.[60]

The decking of the spillway walkway is made up of 18 foot sections of 3 inch by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed onto 3 foot 2 inch sections of 4 inch by 4 inch beams which are bolted to the tops of the horizontal I

beam sections spanning the interior space between the channel beams.[61] In recent years, the wooden decking of the walkway has been replaced with steel grating.

Sluiceway

The sluiceway section of the De Pere dam is centrally located between the two spillways.[62] The overall length of the sluiceway is 355 feet.[63] The sluiceway is comprised of 15 poured concrete construction sections. Each sluiceway construction section is anchored to the bedrock of the river bottom by 4 rows of steel anchor bolts spanning the width of the section. The first row of bolts is located 3 feet from the upstream edge of the section, with subsequent rows spaced at 7 foot intervals. The first and second rows consist of 4 foot lengths of 1 1/2 inch diameter bolts anchored 18 inches into the bedrock. The first row consists of 6 bolts spaced at 4 foot 6 inch intervals, while the second row consists of 5 bolts spaced at 5 foot intervals. The third and fourth rows of bolts each contain five, 1 inch diameter bolts spaced at 5 foot intervals and anchored 18 inches into the bedrock. The bolts in the third row are each 3 feet 6 inches in length, while those of the fourth row are 2 feet 6 inches long. The spillway construction sections are also held to the bottom by a 4 foot wide concrete key, poured into a trench cut to a minimum depth of 2 feet into the bedrock and extending the entire length of the spillway. Additional reinforcement is provided by 4 foot 6 inch long upright sections of rebar which are spaced at 18 inch intervals in two rows 2 feet apart the entire length of the key.[64]

The construction sections of the sluiceway conform to the specifications of a generalized construction section plan.[65] With the exception of the sections at the extreme ends of the sluiceway, which are 15 feet in width, each of the construction sections is 25 feet wide.[66] Measured parallel to the river channel, each section attains a basal length of 28 feet.[67]

Somewhat ramp-shaped in profile, the sluiceway construction sections attain a maximum height of 3 feet above the average elevation of the river bottom, or 580 feet above mean sea level. From an upstream height of 2 feet above the average elevation of the river bottom, the sluiceway sections slope up to achieve this 3 foot height at a horizontal distance of 4 feet from the upstream end. The 3 foot thickness is maintained for a horizontal distance of 8 feet, at which point the section begins to slope gently downstream to a height of 1 foot 2 inches above the average elevation of the river bottom at the extreme downstream edge, or 578.86 feet above mean sea level.[68]

The sluiceway construction sections are secured together by lengths of 3/4 inch and 5/8 inch diameter rebar which run the width of the section and are spaced at 15 inch intervals. The heavier 3/4 inch rebar reinforces the horizontal section of the sluiceway. Additional lengths of 5/8 inch diameter rebar have been placed longitudinally across the section, spaced at 2 foot intervals. The seams between sluiceway construction sections are filled by construction joints.[69]

The sluiceway construction sections of the De Pere dam serve as foundations for a series of 15 upright piers which not only support a sluiceway walkway, but also contain the gate pins on which the sluiceway taintor gates are hung. Thirteen of the sluiceway piers are located along the centerlines of construction sections, while the two end piers are located at the extreme ends of the eastern and western sections.[70] Fourteen sluiceway openings are created by the placement of the pier sections.

The sluiceway piers are 28 feet in length, and measure 5 feet in width. The upstream ends of the piers are parabolic in shape, curved along a radius of 6 feet 3 inches. The upstream nose of each of the piers is armored with a 15 foot 8 inch long section of 4 by 4 by 3/8 inch angle iron secured to the pier with 3/4 inch by 18 inch steel bolts. Sluiceway pier heads extend 3 feet 3 inches from the parabolic tip of the upstream end to the downstream edge. Immediately posterior of the pier

heads is a "stop log" slot which runs the entire height of the pier section. The stop log slots, which are 6 inches deep and 13 inches wide, are located on pier faces interior of sluiceway openings. The downstream corners of the stop log slots have been armored with 15 foot 8 inch long sections of 4 by 4 by 3/8 inch angle iron secured to the pier face with 3/4 inch by 18 inch steel bolts.[71]

The sluiceway piers are tied to the sluiceway construction sections by two rectangular concrete keys, sections of rebar, and anchor bolts. Both concrete keys extend 6 inches from the top of the sluiceway sections into the bottom of the pier sections. The first key, located on top of the horizontal section of the sluiceway construction section, measures 7 feet in length and 2 feet in width. It is secured to the sluiceway construction section with two rows of 5/8 inch diameter by 2 foot anchor bolts spaced at 18 inch intervals along the length of the key. The second key, located on top of the slanted downstream section of the sluiceway construction section, measures 9 feet in length and 2 feet in width. It too is secured to the sluiceway construction section with two rows of 5/8 inch diameter by 2 foot anchor bolts spaced at 18 inch intervals along the length of the key. In addition to the concrete keys, each sluiceway pier is tied into the construction sections with 18 sections of 3/8 inch diameter rebar. The rebar sections are spaced 18 inches center to center, 4 inches inside the outer dimensions of the pier. The lengths of the rebar sections vary according to their position in the pier section, with a 16 foot section utilized in the upstream end, and 12 foot sections used in the downstream end.[72]

In profile, the sluiceway piers are rectangular, with the upstream portion stepped by four 16 inch risers. The tops of the upstream portion of the piers maintain an elevation of 595.67 feet above sea level, while the downstream portions maintain an elevation of 590.33 feet above sea level. The upstream ends of the sluiceway piers are thus 16 feet from the tops of the sluiceway construction sections and the downstream ends are 11 feet 6 inches from the surface of the sections.[73]

Thirteen foot high steel taintor gates are located within each of the sluiceway openings. The taintor gates are hung on a 6 foot 8 inch long, 6 inch diameter cold rolled steel gate pin by a cast steel gate hinge.[74] Each gate is connected to the gate hinges by end girders and bracing composed of 8 by 8 by 3/4 inch angle iron. The upper and lower arms of the end girders are 16 foot sections of angle iron bolted to the gate hinges with 7/8 inch rivets. The upper and lower arms of the taintor gate end girders form the sides of an isosceles triangle with a 40° angle adjacent to the gate hinge. The arms of the end girders are braced with three sections of triangulated 3 by 3 x 3/8 inch angle iron. Two of these angle iron sections are also connected to a 3/8 inch thick steel web plate which spans the space between the upper and lower arms directly behind the taintor gate face. The space between gate end girders is spanned by sections of channel iron running the width of the gate and connecting the upper and lower arms of opposite gate end girders. Additional bracing between end girders is located 5 feet 4 inches behind the gate face at the top and bottom of the gate. A 3/8 inch thick steel web plate is located directly behind the gate face at the centerline of the gate. This web plate is, in turn, tied to the horizontal gate bracing by two 4 foot 9 inch sections of 3 by 3 by 3/8 inch angle iron.[75]

The fronts of the sluiceway gates are faced with 3/8 inch thick steel plates secured to the gate bracing and web plates by 8 inch by 18 1/4 inch horizontal I beams. Seams between the plates are secured by 6 inch wide strips of 3/8 inch steel plate which run the entire height of the taintor gate. A twenty foot long 8 inch by 8 inch oak beam is bolted to the channel iron running along the foot of the gate, providing a sill for the gate.[76]

The sluiceway gates of the De Pere dam are operated by a "crab", a mechanism containing a pair of electric winches that moves from gate to gate along a track on top of the sluiceway.[77] The crab is constructed of two 21 foot lengths of channel iron connected parallel to each other by four sections of 2 foot 2 1/2 inch I beam iron.[78] The crab winches are powered by a five horse power open type

wound rotor motor mounted at the middle of the crab frame. A winch hand wheel is also located near the middle of the crab frame. The crab mechanism rides along a 3 foot 8 inch gauge track mounted along the downstream length of the sluiceway.[79]

In order to raise or lower a gate, the crab is positioned over the gate, and the winch chains are connected to the hoist chain connections on the gate.[80] Once positioned, the crab is connected to a power source, and the winches are turned on until the gate has been raised to the desired height. Once this height is reached, the crab is disconnected from the power source and moved to the next gate to be opened.[81] The electric winches are capable of lifting the gate at a rate of 2 feet per minute. In contrast, 61.5 revolutions of the hand wheel are required to lift the gate 1 foot.[82]

When not in use, the crab mechanism is housed in a wooden structure built over the span between the two easternmost sluiceway piers.[83] The gate hoist house is constructed on top of two 22 foot 4 inch horizontal timbers spanning the space between the sluiceway piers. Along the upstream side of the gate hoist house, a 4 inch by 4 inch sill plate has been bolted directly to the top of the sluiceway walkway planking. The sill plate on the downstream side of the crab house is a 4 inch by 8 inch beam which has been bolted 1 foot 3 inches above the top of the sluiceway pier section. At each end of the sill plates, 4 inch by 4 inch wall studs are fastened directly to the sill plate. Between these beams, 2 inch by 4 inch studs have been spaced 2 feet apart, center to center.[84] On top of the 4 inch by 4 inch wall studs, two 2 inch by 4 inch beams have been strung to form the top plate.

A 2 foot 8 inch personnel door is located on the spillway end of the crab house. A set of double doors on the sluiceway side of the crab house allow the crab to be moved along its track and positioned at the gates. The upstream and downstream sides of the crab house each contain a single window located in the center of the wall. The crab house is covered with a moderately pitched, front-gabled asphalt shingle roof.[85]

A walkway spans the entire length of the sluiceway. The walkway consists of a total of twenty-eight sections of channel iron bolted to the sluiceway pier sections with 3/4 inch by 18 inch split anchor bolts fitted with specially beveled washers. Each side of the walkway is comprised of 14 channel beams bolted end to end, and spaced 2 feet 7 1/2 inches apart so that the channels of opposite beams face one another. The interior space between the channel beams is spanned by forty three 2 foot 7 1/2 inch long I beams which have been bolted to the channel iron using L-shaped braces made of 2 inch sections of 6 by 4 by 3/8 inch angle iron and 1/2 inch by 1 1/2 inch machine bolts.[86] The horizontal I beam sections serve as support ribs spaced 8 feet 4 inches apart along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron have been spaced at 30 foot 6 1/4 inch intervals the length of the sluiceway to form the uprights for a handrail. The sluiceway handrail uprights are constructed of 4 foot sections of 2 1/2 by 2 1/2 by 3/8 inch angle iron.[87]

The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. The second bolt used to secure the upright to the channel beam is located 9 inches above this lower bolt. On each side of the west spillway walkway, two 355 foot lengths of 1/2 inch galvanized 7 strand Siemens - Martin wire rope has been threaded through holes drilled in the walkway uprights. The upright holes are located 2 feet 3 inches and 3 feet 9 inches from the base of the walkway channel beam. The ends of the wire rope have been looped and secured with three bolt guy clamps, and connected to 3/4 inch eye bolts fastened to 3/4 inch turnbuckles.[88]

The decking of the spillway walkway is made up of 25 foot sections of 3 inch by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed to 2 foot 4 inch sections of 4 inch by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams.[89] In recent years, the wooden decking of the walkway has been replaced with steel grating.

A 5 foot 4 inch wide by 8 foot long steamhouse is located on top of the fourth sluiceway pier from the end of the eastern spillway. Constructed in 1982, the steamhouse is a pre-fabricated structure manufactured by Armco Building Systems of Cincinnati, Ohio. The modular wall panels, which are bolted directly onto the sluiceway pier, support four 16 inch roof panels.[90] An entrance door is located on the upstream side of the steamhouse, and a single, louvered vent is centered on the downstream side.[91]

The steamhouse provides storage for a portable steam cleaner used to periodically clean the dam surface and gates. The steam cleaner is also used to melt ice that builds up on the gates and hampers gate operation during the winter.[92]

DE PERE CANAL

The De Pere locks are located within an artificially created canal that bypasses the De Pere dam to the east.[93] The De Pere canal was excavated sometime prior to 1848, when Wisconsin Board of Public Works engineer Condy R. Alton reported the wooden locks at De Pere to be in poor condition.[94] Along with his suggestion for a new stone lock at De Pere, Alton proposed the construction of a 1,200 foot canal.[95] Although a stone lock was constructed at De Pere after Alton's survey, his suggestions for the canal seem to have gone unheeded. When the De Pere lock was surveyed again in 1866, the canal was reported to be 750 feet long.[96]

Today, the De Pere lock canal is approximately 1,500 feet in length, including the portion of the canal that lies within the lock. Roughly 625 feet of the canal is located below the lower wing walls of the lock, and 664 feet above the upper wing walls.[97] The lower canal is 100 feet wide and was created by removing the rock ledge below the lock to maintain an average depth of 9.6 feet. The upper canal at De Pere extends above the upper wing walls to the east abutment of the De Pere dam. The upper canal is much wider than the lower canal, forming a 300 foot wide canal basin south of the lock. The dredged portion of the upper lock maintains an average depth of 8 feet 6 inches.[98]

Many stretches of the De Pere lock canal have bank areas covered with stone riprapping or concrete and limestone facing. For example, the bank of the lower canal, nearest to the Fox River (i.e., the west bank) has been completely riprapped with stone. This bank lies along a small peninsula created from sediments and stone dredged from the lock canal and deposited on the western edge of the canal. The eastern bank of the lower canal borders a public park adjacent to the lock complex. The east bank has been faced with limestone slabs capped with concrete. In addition, a concrete walkway extends along the entire length of the eastern side of the lower canal.

The banks of the upper canal and canal basin have been similarly reinforced. The eastern bank of the upper canal is riprapped with stone in most areas. Remaining portions, particularly those adjacent to recent commercial developments and residential building have been riprapped with stone and capped with concrete. The entire length of the west bank of the upper canal has also been riprapped and capped with concrete.

DE PERE LOCK

The De Pere lock has changed little since its construction was completed in 1936. The lock consists of a 211 foot 6 inch concrete lock chamber with concrete wing walls at each end.[99]

The lower wing walls, or those located at the downstream end of the lock, are each 11 feet 9 inches high. Each lower wing wall consists of two construction sections tied together by a 6 inch concrete key. Each construction section is made up of a 7 foot 9 inch high upper section built on top of a concrete slab measuring 4 feet in height, and 10 feet in width.[100] The slab is secured to bedrock by two rows of 4 foot long sections of 1/2 inch split anchor bolts spaced at 4 foot intervals center to center. The upper sections of the lower wing walls are secured to the concrete slab by a 2 foot wide concrete key which runs the entire length of the wing wall and extends 6 inches into the bases of the upper sections.[101]

The upper sections of the lower wing walls are 7 feet 10 1/2 inches long at the base, and are beveled to a width of 3 feet 10 inches at the top.[102] The top of each lower wing wall maintains a level surface at 584.75 feet above sea level to a point 10 feet from the base of the lock chamber. From this point, the surface of the wing wall is stepped up to the 593.5 feet above sea level elevation of the lock chamber by a series of seven 1 foot 3 inch high risers. Each of the lower wing walls is 54 feet in total length. The inside surfaces of the wing walls are reinforced with four 26 foot long 12 inch by 12 inch wale timbers attached to the wall in two horizontal rows. The upper wale timber is positioned 2 feet 3 inches below the top of the wing wall, while the second timber is placed 2 feet 6 inches below the upper timber.[103]

The upper wing wall is similar to the lower wing wall, except that its construction is somewhat more massive.[104] Both of the upper wing walls are made up of two construction sections, each 15 feet 8 inches in height. Like the lower wing walls, the upper wing walls consist of a wall section built on top of a concrete slab. The concrete slab base of the upper wing wall is secured to bedrock by two rows of 4 foot long sections of 1/2 inch split anchor bolts. Additionally, a 3 foot wide poured concrete key that extends 18 inches into the bedrock runs the entire length of the wing wall. The upper section of the upper wing wall is secured to the concrete slab by a 2 foot wide concrete key which runs the entire length of the wing wall and extends from the concrete slab 6 inches into the base of the upper section. The upper section of the lower wing wall is 9 feet 9 inches at the base, and is beveled to a 4 foot width at the top. Each of the upper wing walls measure 50 feet in total length. The inside surfaces of the bankward side of the upper wing wall is reinforced with two 26 foot long 12 inch by 12 inch wale timbers. The upper wale timber is positioned 2 feet 3 inches below the top of the wing wall, while the second timber is placed 2 feet 6 inches below the upper timber.[105]

The lock chamber of the De Pere lock extends 171 feet from quoin to quoin. Additionally, there is a 28 foot 6 inch upper gate section and a 12 foot lower gate section which increase the overall length of the lock to 211 feet 6 inches.[106] The upper gate section, located at the upstream end of the lock, is defined as that part of the lock structure upstream of the upper gate mitre plate, which includes the upper gate and the valves used in filling the lock.

Spaced 36 feet apart, the walls of the upper gate section are each 39 feet 6 inches in length.[107] The walls are made up of an upper section and a lower section which serves as a base for the upper section. The base of the upper gate section walls is a 39 foot 6 inch long concrete slab which is 20 feet wide and 4 feet thick. The top of the concrete slab is elevated 577.0 feet above sea level. The base of the upper gate section is ell shaped in appearance, with the shorter vertical leg extending 6 inches into the bedrock floor of the lock chamber. The base of both the upper gate section walls is

tied to the bedrock adjacent to the lock chamber with 1 1/2 inchdiameter anchor bolts imbedded not less than 2 feet into the bedrock.[108]

The upper section of the wall is secured to the base with a 4 foot wide concrete key which runs the entire length of the wall and extends 6 inches into the bottom of the upper wall section. The base of the upper section is 17 feet 5 1/2 inches in width, and is beveled to a 6 foot 6 inchwidth at the top of the section. The interior walls of the upper gate section are aligned so as to be flush to one another.[109] Directly behind the lock gates, the interior faces of the upper gate section walls are recessed 2 feet 2 inches in order to allow the gates to recess fully when completely opened.[110]

Six butterfly valves are utilized to allow the water level of the lock chamber to be raised. Three valves are grouped on either side of the upper gate section floor immediately outside of the lock gates.[111] When the lock is to be flooded, the lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall.[112] A horizontal bar is inserted into a socketed hub attached to a vertical shaft and serves as a handle with which to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.[113]

When the gate is closed and sealed, the butterfly valves are opened and water is allowed to flow through a culvert below the mitre sill and into the lock.[114] When opened, the six upstream valves fill the lock chamber to provide 9.86 feet of lift and match the 588.36 elevation of the upper pool in under 3 minutes.[115]

The lower gate section of the De Pere lock consists of two 39 foot 6 inch long concrete walls spaced 36 feet apart.[116] The lower gate section walls are made up of an upper section supported by a lower base section. The base of the lower gate section walls is a 39 foot 6 inch long concrete slab that is 22 feet wide and 4 feet thick. The top of the base is elevated 577.0 feet above sea level. The base is ell-shaped in appearance, with the shorter vertical leg extending 6 inches into the bedrock floor of the lock chamber. The base is tied to the bedrock adjacent to the lock chamber with 1 1/2 inch diameter anchor bolts imbedded not less than 2 feet into the bedrock.[117]

The upper section of the lower gate section wall is secured to the base with a 4 foot wide concrete key which runs the entire length of the lower gate section and extends 6 inches into the bottom of the upper section. The base of the upper section is 16 feet 6 inches in width, and is beveled to 6 feet 6 inches at the top. The interior walls of the upper and lower sections are aligned flush with one another.[118] Directly in front of the downstream lock gates, the faces of the lock walls are recessed 2 feet 2 inches in order to allow the fully opened gates to recess flush.[119]

Six valves are located in the floor of the lower gate section, placed three on each side of the lock. When opened, these valves allow water to flow through a culvert under the lower gate sill to drain the lock. The discharge valves are operated by geared mechanisms connected to hand wheels mounted on top of the lock wall near the lower gate. When opened, the lower valves can discharge the lock chamber to the lower pool elevation in a little over 2 minutes.[120]

The lower gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts mounted on steel tripods located on both sides of the lock wall.[121] A horizontal bar is inserted into a socketed hub attached to the vertical shaft and serves as a handle with which to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a

counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.[122]

The lower gates are constructed of 19 foot 2 3/4 inch long 15 inch wide horizontal channel iron beams bolted to 27 foot 10 inch long vertical I beams to form the gate frame.[123] At the bottom of the gate, a 15 inch 55 pound channel iron is used for the gate sill, and a 15 inch 33.9 pound channel iron provides horizontal support at the top of the gate. Between these channel iron beams, horizontal I beams of various gauges have been bolted between the vertical I beams. The first four horizontal supports above the sill plate channel iron are constructed from 75 pound iron, the two above these are made from 60.8 pound iron, and the next three from 42.9 pound iron.[124] Including the channel irons at the top and bottom of the gate, there are a total of 11 horizontal support members on each of the lower gates.

The spacing between the horizontal supports varies according to where they are located on the gate. Where greater rigidity is required, the space between the horizontal supports is decreased. Beginning at the sill plate and moving toward the top of the gate, the spacing between the horizontal I beams is as follows: 2 feet 7 1/8 inches between the sill and the first support; 2 feet 4 inches between the first and second supports; 2 feet 4 1/2 inches between second and third supports; 2 feet 6 inches between the third and fourth, and the fourth and fifth supports; 2 feet 8 inches between the fifth and sixth supports; 2 feet 10 inches between the sixth and seventh supports; 2 feet 11 inches between the seventh and eighth, and the eighth and ninth supports; and 3 feet 4 1/2 inches between the ninth support and the channel iron at the top of the gate.[125]

Between certain rows of the horizontal I beams, lengths of 4 by 3 by 3/8 inch angle iron stiffeners have been placed in five vertical columns to provide additional rigidity. The lengths of the stiffeners corresponds to the appropriate length necessary to span the space between each of the rows. The stiffener columns are placed between the horizontal rows beginning at the first row above the gate sill plate up to the third row from the top of the gate. The first columns are spaced 3 feet 4 3/8 inches inside both ends of the gate, and the other columns are evenly spaced at 3 foot 1 1/2 inch intervals between these columns.[126]

The spaces between the horizontal I beams and the vertical stiffeners of each gate are filled by 5/16 inch thick steel plate fastened to the frame with 3/4 inch rivets. A diagonal eye bar strung from the upper outside to lower inside corner of the gate and tightened with a turnbuckle supplies additional support and rigidity.[127]

At the bottom of each of the lower gates, a 5 inch by 8 inch oak beam cut to the length of the gate is fitted to the outside of the lower channel iron. At the top of each gate, a 21 foot 2 inch long 1/2 inch by 15 3/4 inch wide oak plank is fitted to the upper channel to form a walkway. On the interior of the lower gate, from the second to the sixth horizontal row below the top, nineteen 3 foot by 10 inch oak plank fenders are hung vertically. These planks provide a measure of protection to vessels inside the lock.[128]

The upper gates are similar to the lower gates in their construction, except that they are considerably shorter in height. The upper gates are constructed of 19 foot 2 3/4 inch long 15 inch wide horizontal channel iron beams bolted to 15 foot 5 3/8 inch long vertical I beams to form the gate frame. At the bottom of the gate, a 15 inch 55 pound channel iron is used to form the sill plate attachment, and a 15 inch 33.9 pound horizontal channel iron is used as the top gate support. Between the upper and lower horizontal channel irons, I beams of varying gauges have been bolted to the vertical I beams. The first horizontal support above the channel iron at the sill plate is constructed from 60.8 pound iron, while the remaining three are made of 42.9 pound iron.[129]

Including the channel irons at the top and bottom of the gate, there are a total of 6 horizontal support irons on each of the upper gates.

The horizontal supports are spaced at different intervals from each other, depending on their location in the gate. Where greater rigidity is required, the spacing is decreased. Beginning at the sill plate and moving toward the top of the gate, the spacing between the horizontal I beams is as follows: 2 feet 7 1/8 inches between the sill and the first support; 2 feet 10 inches between the first and second supports; 2 feet 11 inches between the second and third supports and the third and fourth supports; and 3 feet 4 1/2 inches between the fourth support and the channel iron at the top of the gate.[130]

Between certain rows of the horizontal I beams, lengths of 4 by 3 by 3/8 inch angle iron stiffeners have been placed in five vertical columns to provide additional rigidity to the gate. The lengths of the stiffeners corresponds to the appropriate length necessary to span the space between each of the rows. The stiffener columns are placed between the horizontal rows beginning at the first row above the gate sill plate up to the third row from the top of the gate. The first columns are spaced 3 feet 4 3/8 inches inside both ends of the gate, and the other columns are evenly spaced at 3 foot 1 1/2 inch intervals between these columns.[131]

At the bottom of each of the upper gates, a 5 inch by 8 inch oak beam cut to the length of the gate is fitted to the outside of the lower channel iron. At the top of each gate, a 21 foot 2 inch long 1/2 inch by 15 3/4 inch wide oak plank is fitted to the upper channel iron to form a walkway. On the interior of the upper gate, from the top to the first horizontal row above the sill plate, nineteen 3 foot by 10 inch oak plank fenders are hung vertically, providing protection to vessels inside the lock.[132]

Each side of the lock chamber between the upper and lower gate sections is made up of five 28 foot high concrete construction sections placed 36 feet apart, and tied end to end by 2 foot wide, 6 inch deep concrete keys running the entire height of the section. Expansion joints are placed in the seams between the sections, and 3/8 inch by 1 foot cut-off plates or 1/32 inch by 1 foot 3 inch soft copper plates extending the entire height of the section, have been placed in alternate keys between sections.[133]

Each of the construction sections which make up the lock chamber walls is made up of two sections, an upper section, and a lower section which serves as a base for the upper section. The base of a lock chamber wall section consists of a 39 foot 6 inch long concrete slab which is 20 feet wide and 4 feet thick. The top of the lower section is elevated 577.0 feet above sea level. The base is ell-shaped with the 6 foot long vertical leg extending 6 inches into the bedrock floor of the lock chamber. The base of the forechamber wall is tied into the bedrock adjacent to the lock chamber with 1 1/2 inch diameter anchor bolts imbedded not less than 2 feet into the bedrock.[134]

The upper section of each lock chamber wall construction section is secured to the base with a 4 foot wide concrete key which runs the entire length of the lock chamber base section and extends 6 inches into the bottom of the upper section. At its base, the upper section measures 17 feet 5 1/2 inches in width, and is beveled to 6 feet 6 inches at the top of the section. The interior walls of the upper and lower sections of a lock chamber construction section are aligned flush with one another.[135] Elevation at the top of the lock chamber wall is 593.5 feet above sea level.[136]

In the sections immediately adjacent to the upper and lower gate sections, a 1 foot 8 inch wide ladder is recessed into the interior wall. The rungs of the ladder are constructed from twenty-three 1 foot 1/4 inch diameter bars spaced 1 foot 2 inches from one another. Also located on the inside face of alternating lock chamber sections are snubbing posts placed in 2 foot by 6 foot openings

recessed approximately 2 feet into the lock wall.[137] The snubbing posts are used to secure lines to vessels passing through the lock.

Subsequent to wall construction, the backslopes of all walls were backfilled with clay to the tops of the walls and shaped to provide drainage.[138]

Subsequent to the initial construction of the locks, pipe guard rails were added along the top inside surface of walls on both sides of lock and wing walls, and on both sides of the planking on top of the lock gates. Apart from these superficial improvements and periodic repair and maintenance, the locks are little changed since construction of the concrete lock was completed in 1936.

SIGNIFICANCE

The De Pere Lock and Dam Complex is a part of the Lower Fox River Waterway System constructed by private companies between 1850 and 1860 and rebuilt by the United States Army Corps of Engineers between 1872 and 1936. Conceived as part of the larger Fox River Waterway, the Lower Fox River System operated between Green Bay and Lake Winnebago. The lock and dam complex at De Pere allows passage from Green Bay into the Lower Fox River and serves as an integral part of the Lower Fox River Waterway System.

ENDNOTES

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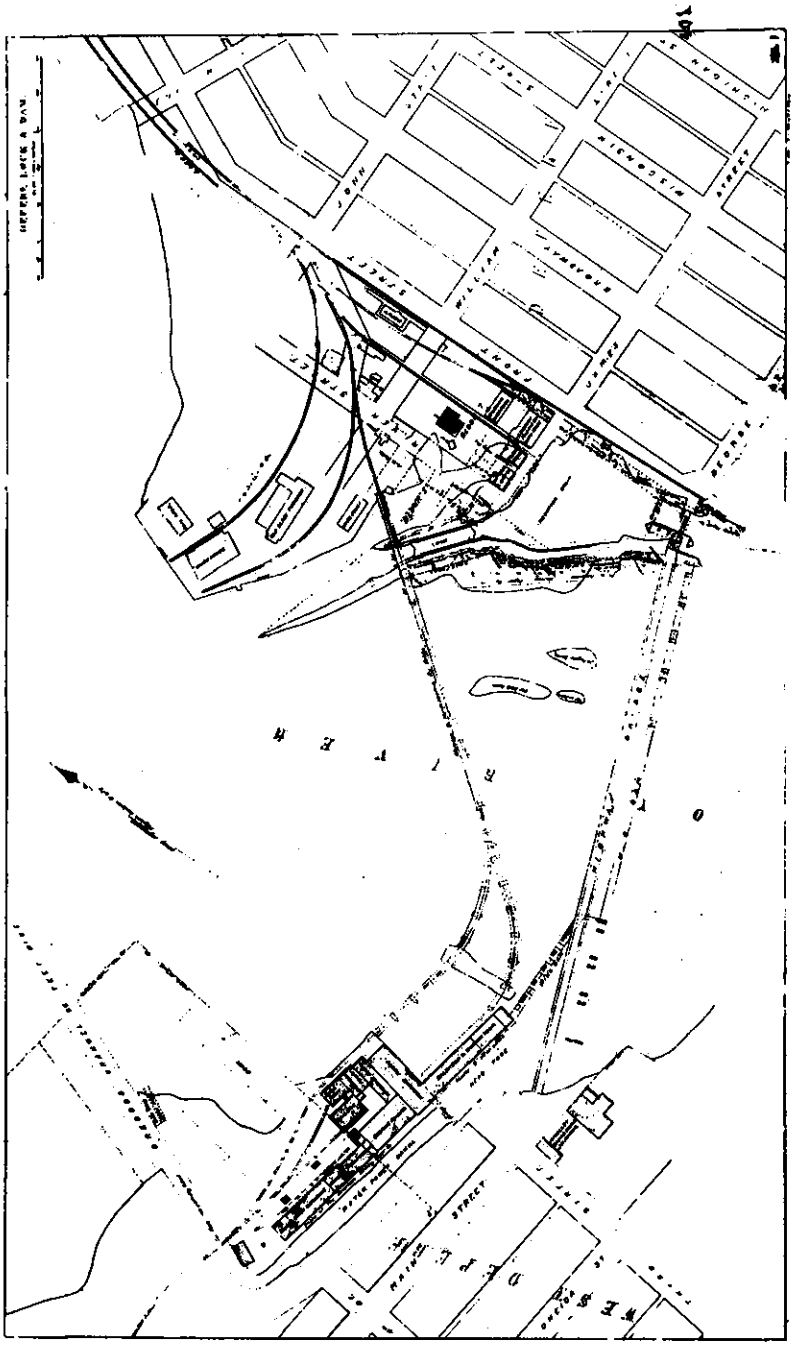

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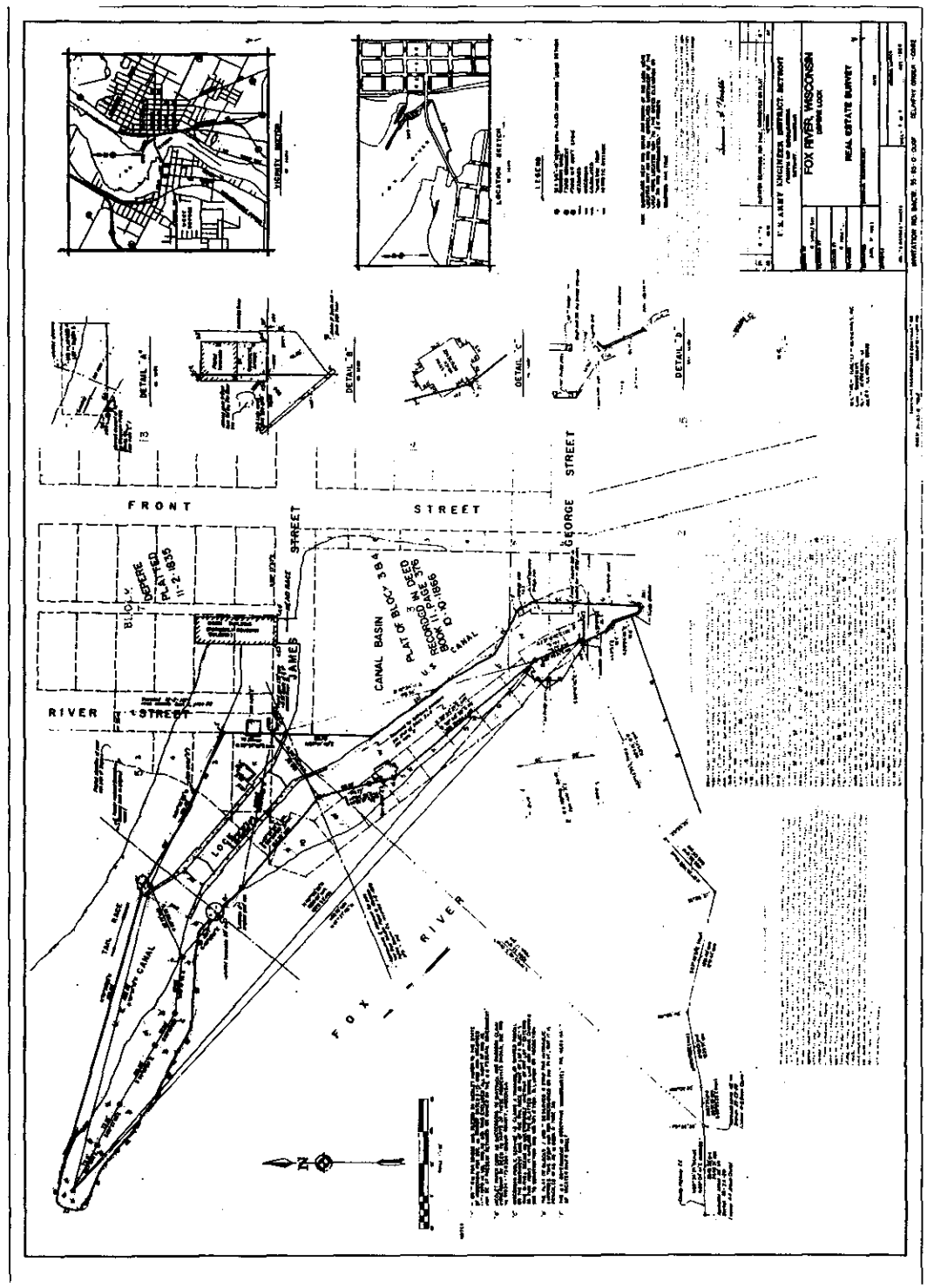

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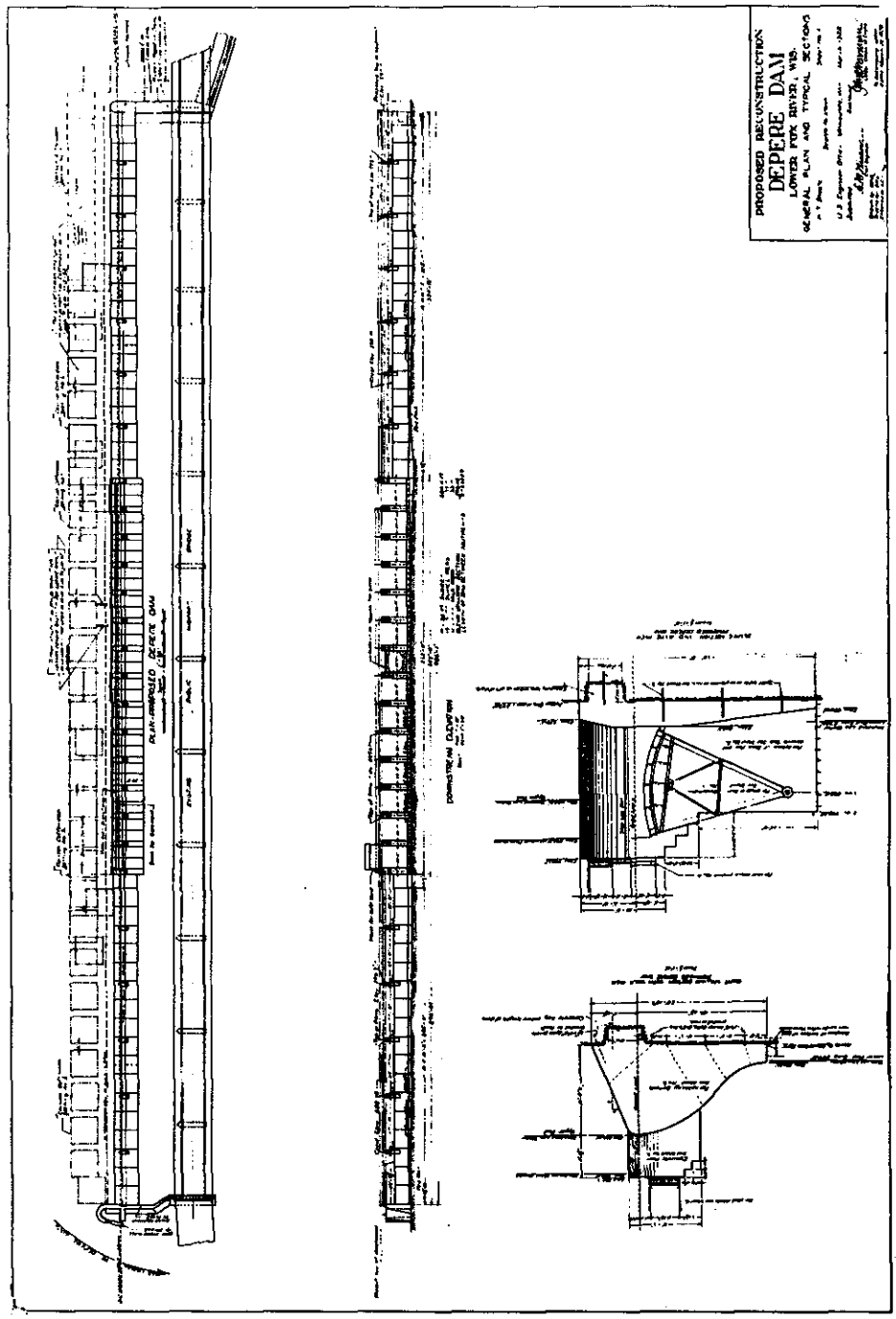

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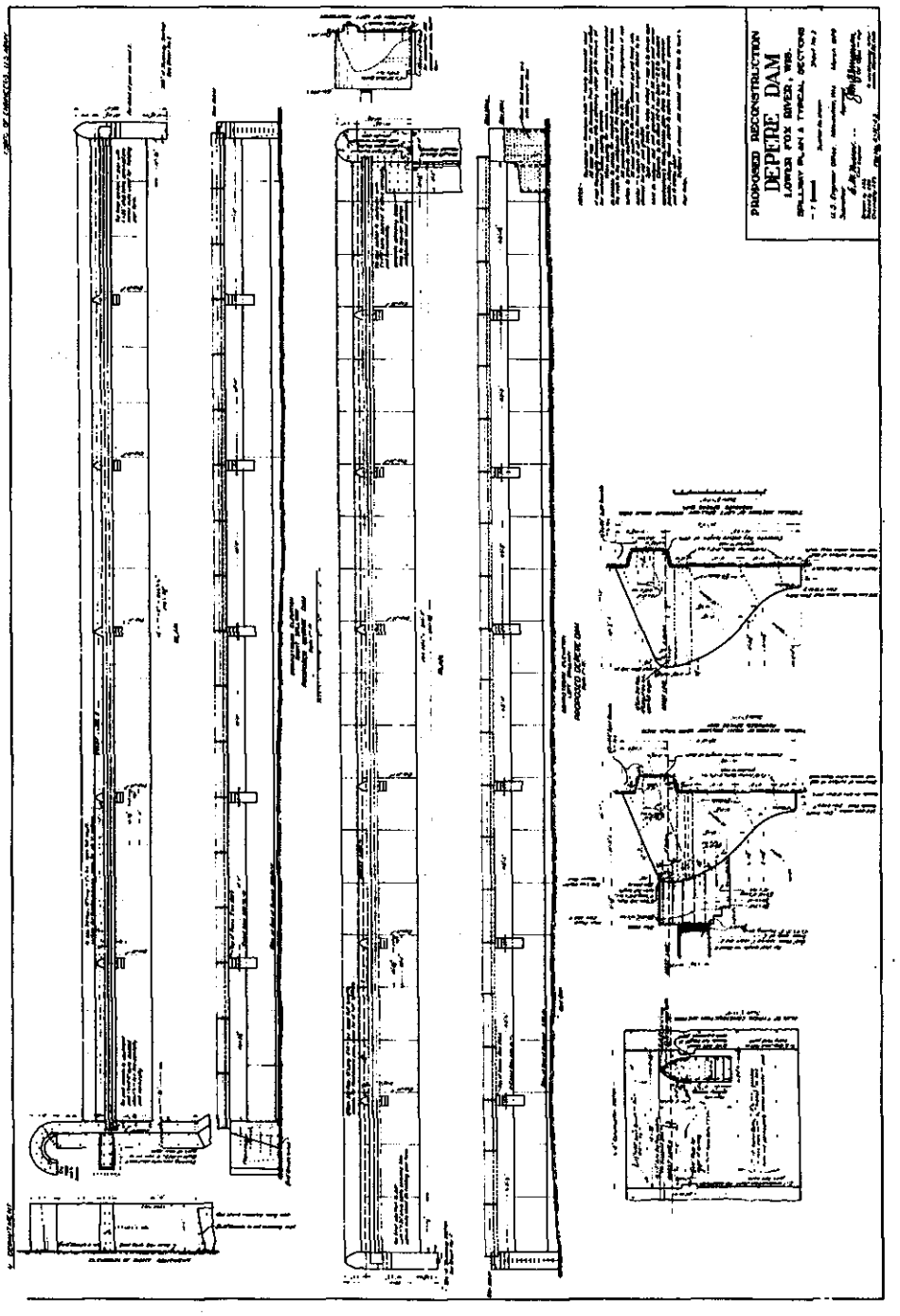

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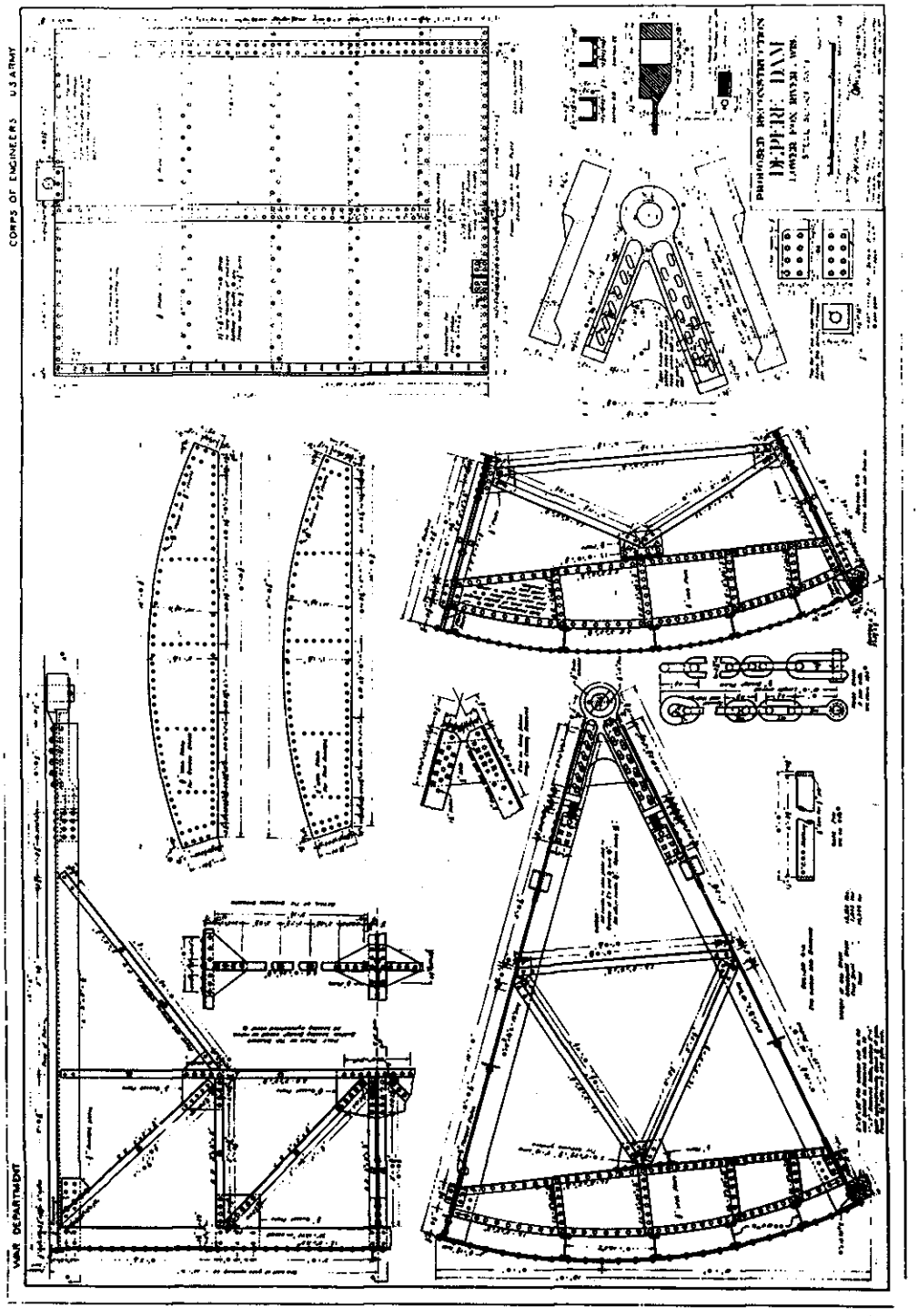

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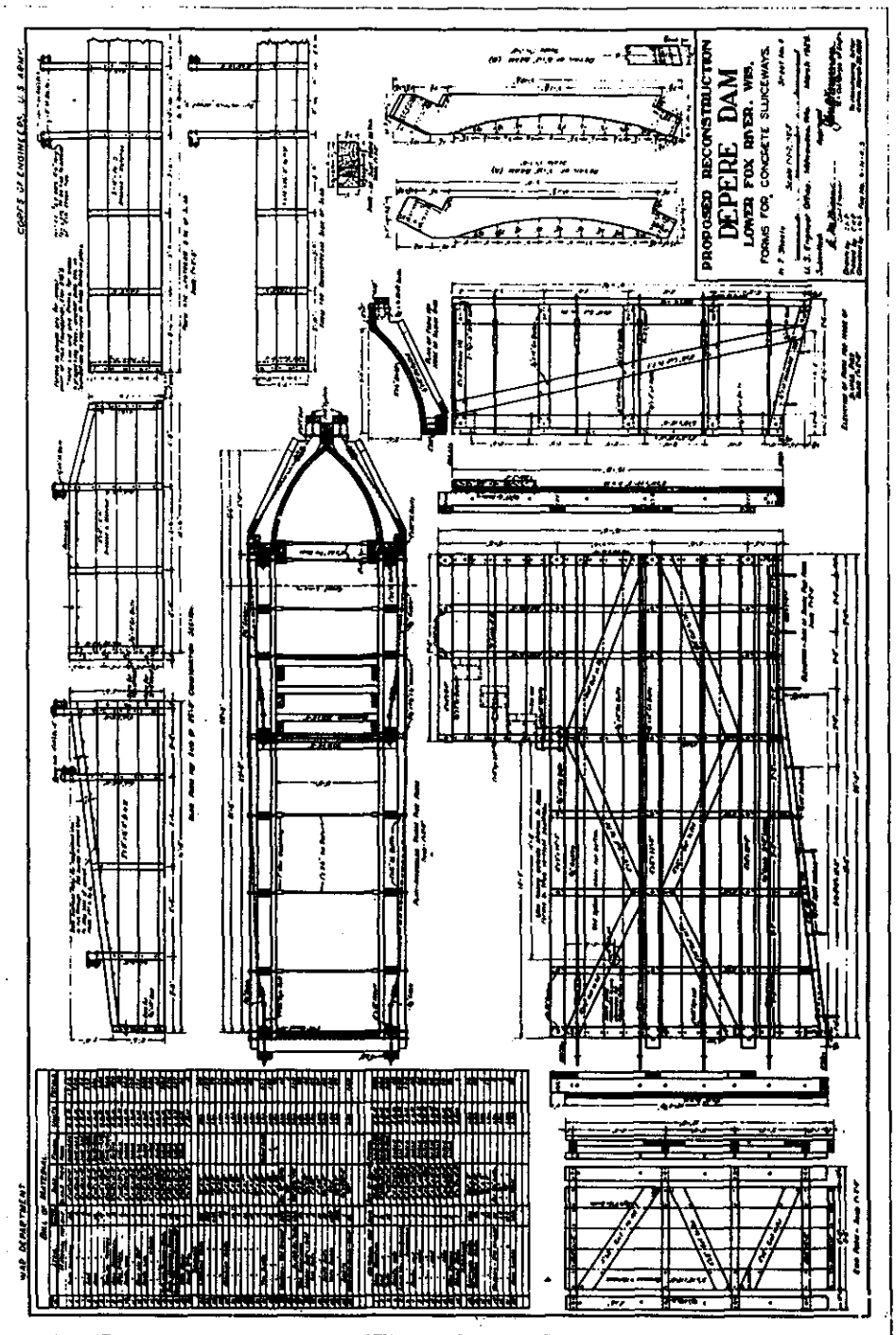

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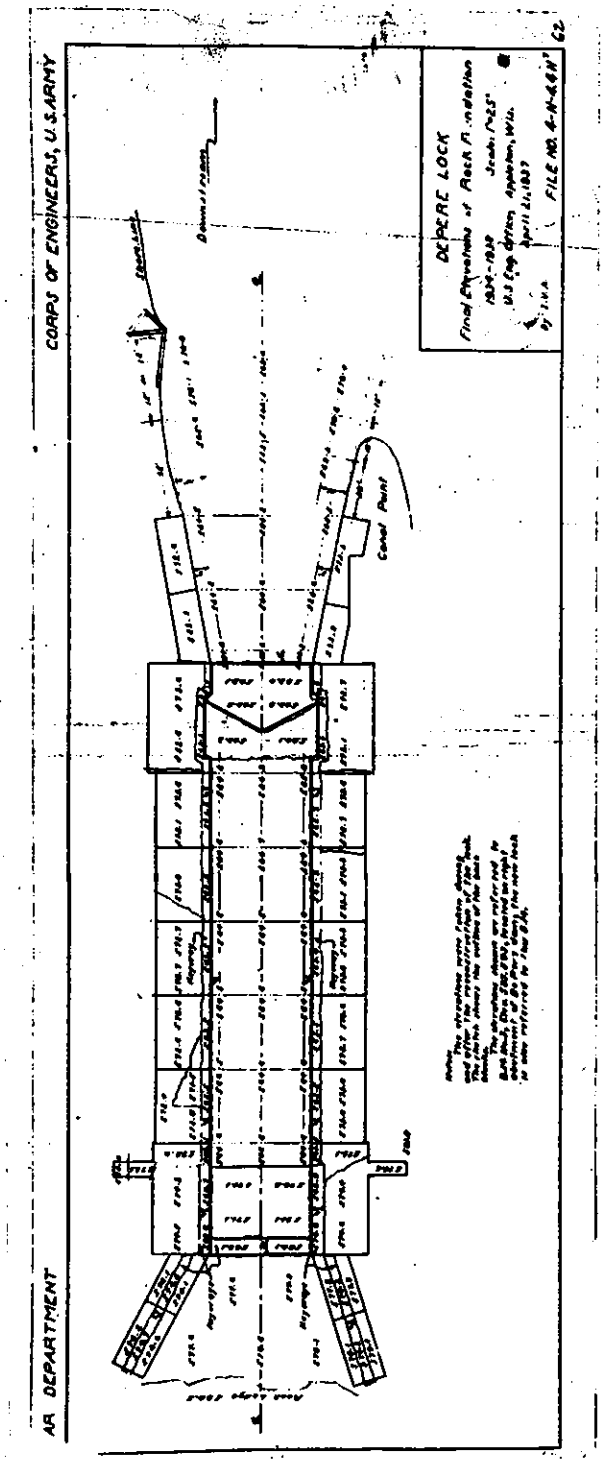

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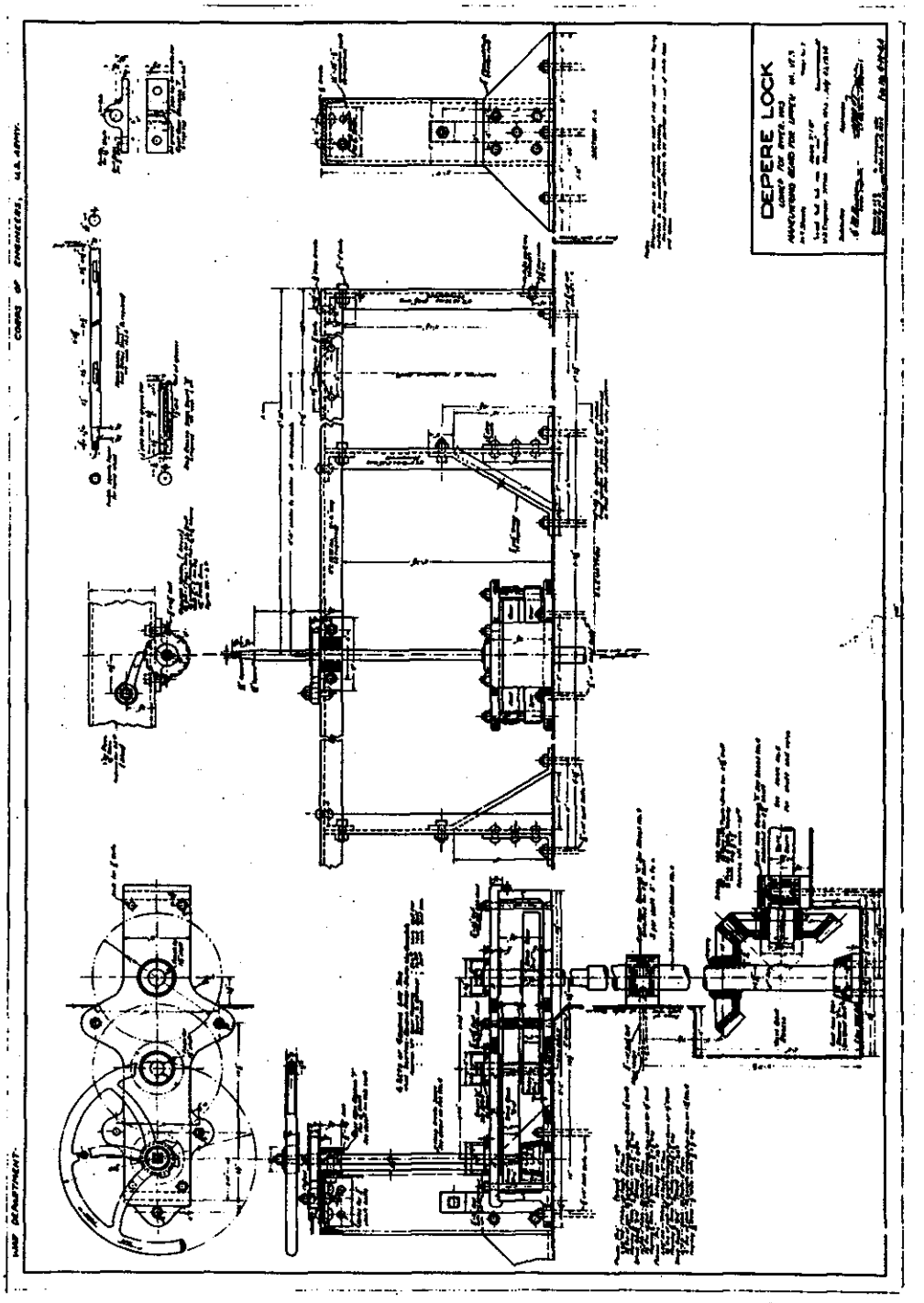

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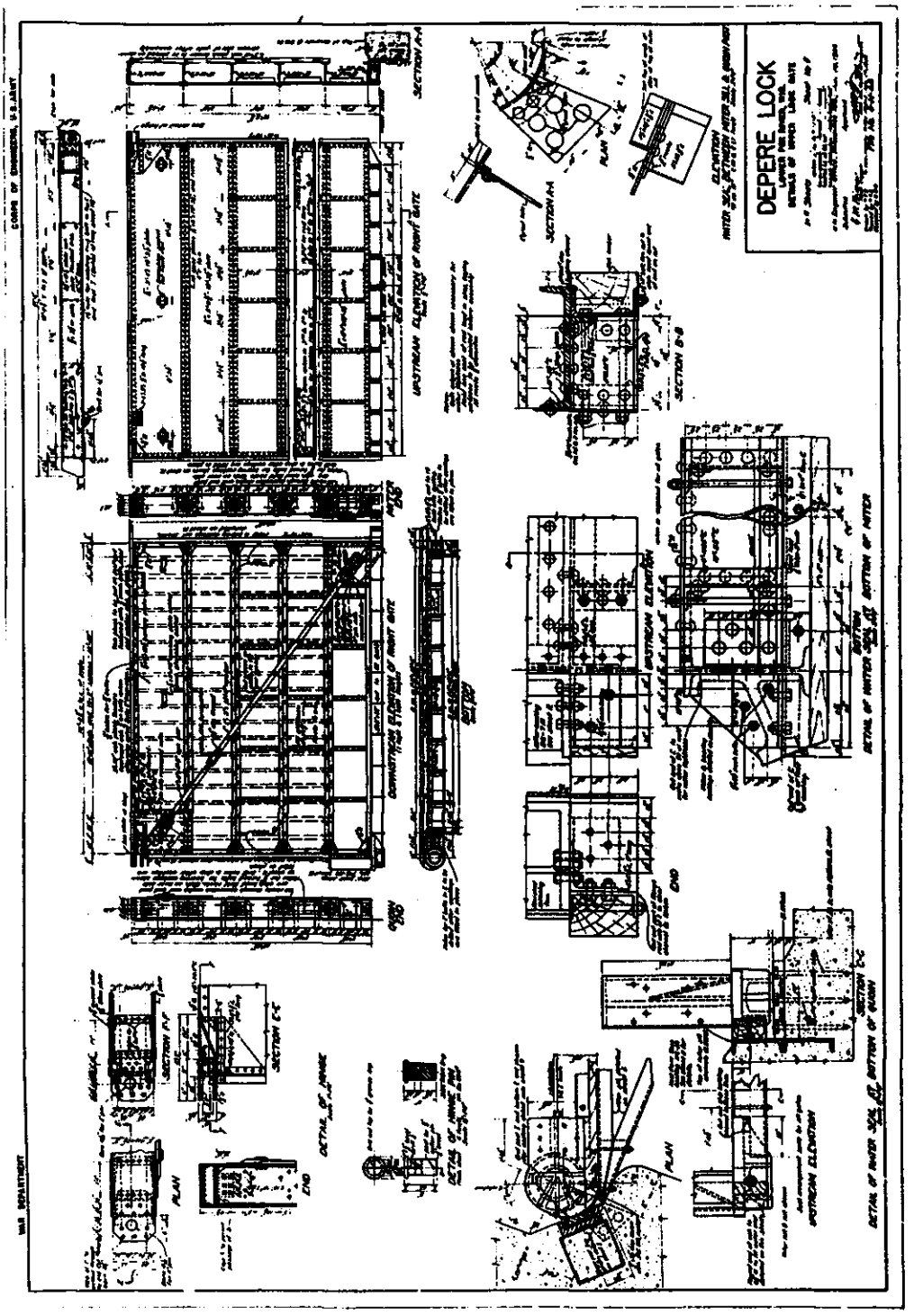

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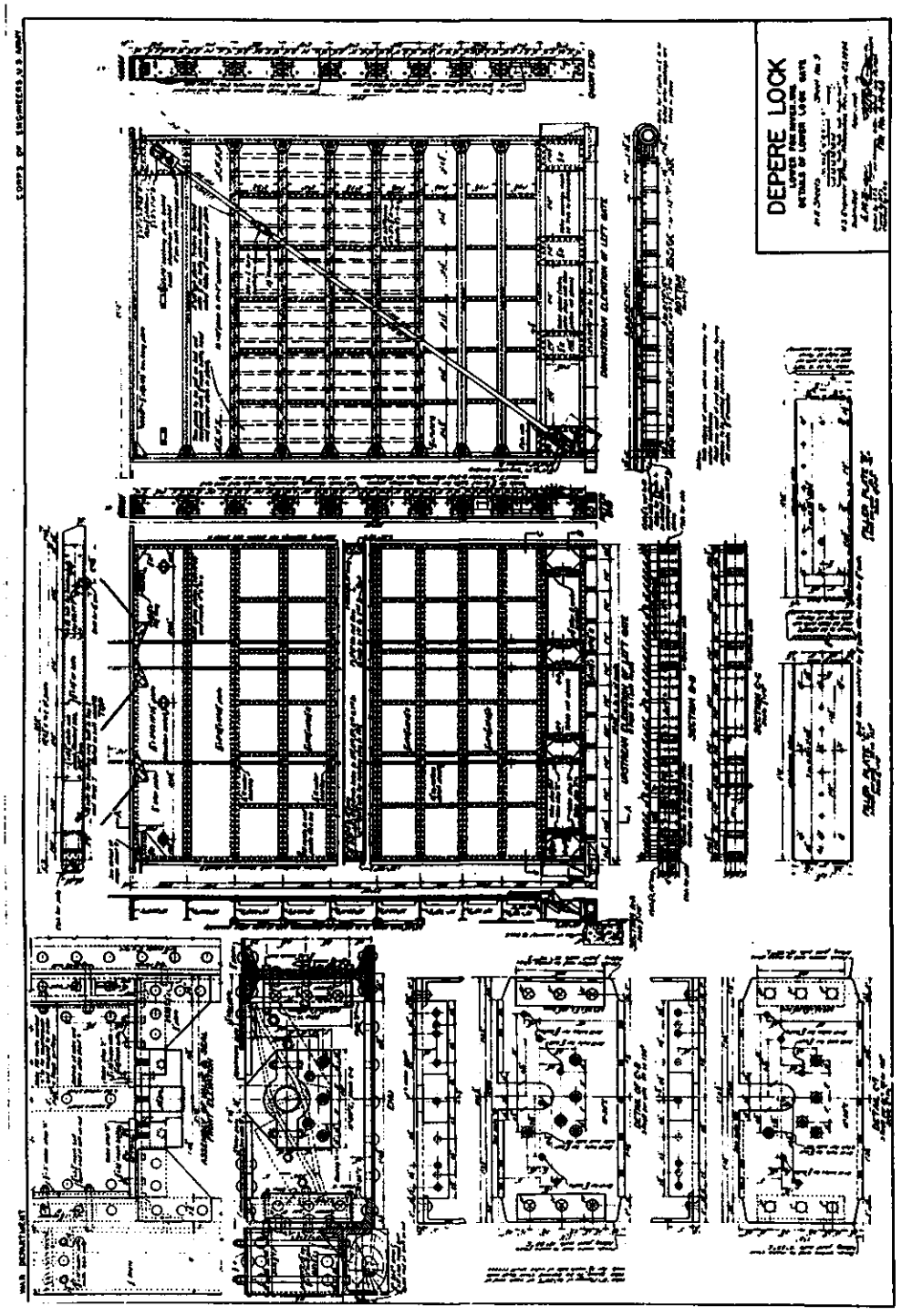

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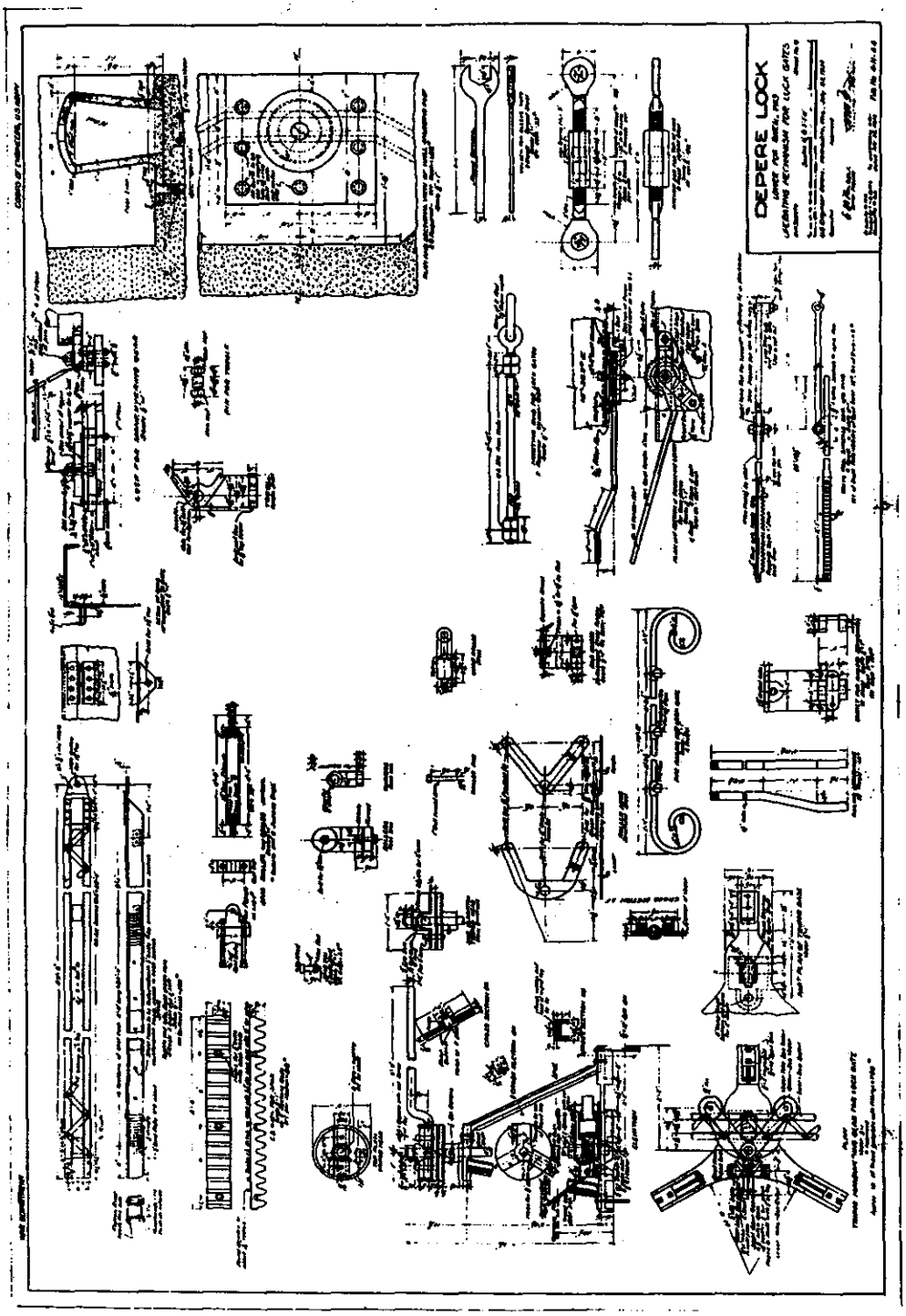

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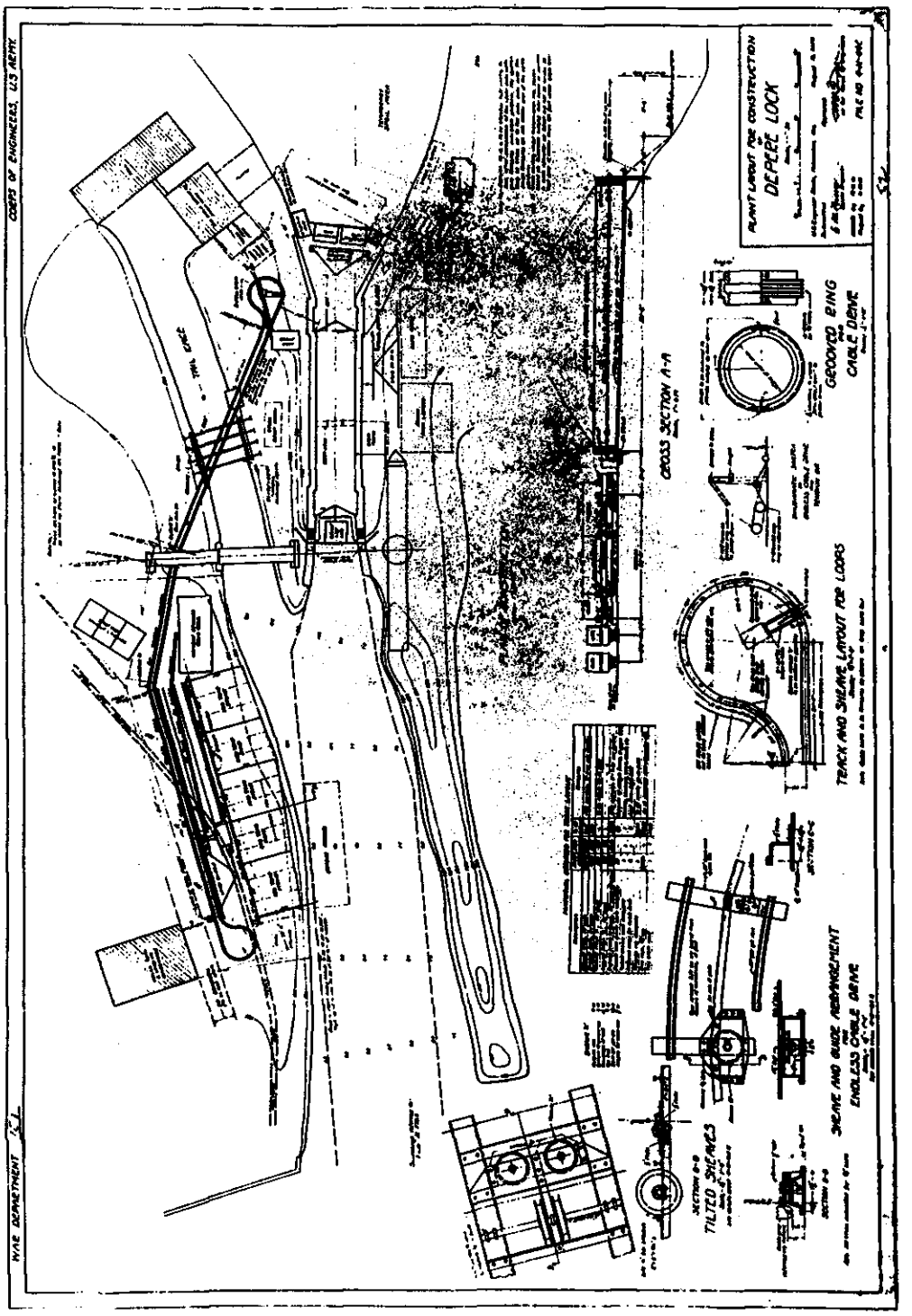

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